CLAIMS

What is claimed is:

1. An integrated circuit module including:

a substrate for mounting one or more chips or discrete electronic components; and

a cap for covering said substrate, and including at least one protrusion coupled to the cap for limiting the amount of flexing of the substrate during actuation.

2. The integrated circuit module according to claim 1, wherein said cap is for mechanically protecting the chip, and for providing a heat transfer path from a back side of the chip to an external cooling environment.

3. The integrated circuit module according to claim 1, wherein said at least one protrusion is a predetermined distance from an opposing surface of said substrate during an unloaded state of said module, said predetermined distance being substantially within a range of about 0.000 inches to about 0.003 inches above the substrate surface.

4. The integrated circuit module according to claim 1, wherein, in the unloaded state, the at least one protrusion is located above the substrate by a distance substantially within a range of about 0.000 to about 0.003 inches.

5. The integrated circuit module according to claim 1, wherein said at least one protrusion is formed on a same plane as a bottom surface of said cap.

6. The integrated circuit module according to claim 1, wherein said at least one protrusion extends not completely to a surface of the substrate opposing the protrusions.

7. The integrated circuit module according to claim 1, wherein said at least one protrusion is preloaded against said substrate.

8. The integrated circuit module according to claim 1, wherein said at least one protrusion includes a gimbaled or otherwise movable contact surface which self-registers against the substrate or an opposite contact surface.

9. The integrated circuit module according to claim 1, wherein the at least one protrusion is capped with an elastomer layer.

10. The integrated circuit module according to claim 1, wherein said substrate includes an elastomer member mounted in an area of said substrate corresponding to said at least one protrusion when the cap is joined to said substrate.

11. The integrated circuit module according to claim 1, wherein said at least one protrusion includes one of a rounded surface and a spherical contact surfaced for centered contact.

12. The integrated circuit module according to claim 1, wherein the at least one protrusion is located substantially in a range of about 1/3 to about 1/4 the diagonal distance from a center to a corner of the substrate.

13. The integrated circuit module according to claim 1, wherein said at least one protrusion is located substantially near the center of said substrate.

14. The integrated circuit module according to claim 1, wherein the cap includes sealing legs at a periphery of said cap, and a bottom surface of said at least one protrusion is substantially on a same plane as an interface between the bottom surface of the sealing legs of the cap and such that a clearance of substantially within a range of about 0.000 inches to about 0.003 inches, is provided between the bottom surface of said at least one protrusion and the opposing surface of the substrate.

15. The integrated circuit module according to claim 1, wherein said at least one protrusion is integrally formed with said cap.

16. The integrated circuit module according to claim 1, wherein said at least one protrusion is rigidly fixed to said cap.

17. The integrated circuit module according to claim 1, wherein said at least one protrusion is attached permanently to said substrate.

18. The integrated circuit module according to claim 1, wherein said at least one protrusion is formed as walls of said cap.

19. The integrated circuit module according to claim 1, wherein a position of said at least one protrusion is selectively adjustable in relation to said substrate to accommodate different stresses and loading on said substrate.

20. The integrated circuit module according to claim 19, wherein said at least one protrusion comprises an adjustable spar, screw or set-screw.

21. The integrated circuit module according to claim 19, wherein said at least one protrusion is rotated to be threaded through said cap to adjust a distance of a bottom of said protrusion from a top surface of said substrate.

22. The integrated circuit module according to claim 19, wherein said at least one protrusion comprises a rivet for being adjustably inserted through said cap.

23. The integrated circuit module according to claim 19, wherein said at least one protrusion comprises a threaded cylindrical object.

24. The integrated circuit module according to claim 19, wherein said at least one protrusion is adjustably fitted through said cap such that a bottom surface of said at least one protrusion is flush with a top surface of said substrate.

25. The integrated circuit module according to claim 19, wherein said at least one protrusion is adjustably fitted to form a predetermined gap between a tip of said at least one protrusion and said substrate.

26. The integrated circuit module according to claim 19, wherein said at least one protrusion includes threads which are sealed to prevent leakage and retain the protrusion position.

27. The integrated circuit module according to claim 19, wherein an interposing layer of curable or hardened material is interposed between said at least one protrusion and said substrate.

28. The integrated circuit module according to claim 19, wherein said curable or hardened material comprises epoxy.

29. The integrated circuit module according to claim 1, further comprising:

a contact plate formed on said substrate for spreading a reaction load between said at least one protrusion and said substrate.

30. The integrated circuit module according to claim 29, wherein said contact plate comprises steel or another material having a hardness substantially the same as steel.

31. The integrated circuit module according to claim 29, wherein said contact plate comprises a cylindrical plate or column.

32. The integrated circuit module according to claim 29, wherein said contact plate is attached to said substrate.

33. The integrated circuit module according to claim 29, wherein said contact plate is pre-attached to a tip of said at least one protrusion.

34. The integrated circuit module according to claim 33, wherein said contact plate is gimbaled or otherwise includes a movable contact surface which self-registers against the substrate or an opposite contact surface.

35. The integrated circuit module according to claim 29, wherein said contact plate protects a surface of said substrate from scratching damage.

36. The integrated circuit module according to claim 29, wherein said contact plate protects said substrate from excessive surface pressure.

37. The integrated circuit module according to claim 29, wherein said contact plate is retained and located with a counterbore in said substrate.

38. The integrated circuit module according to claim 29, wherein said contact plate includes at least one rounded contact surface for centered contact to said at least one protrusion.

39. A land grid assembly (LGA) comprising:

a module having a substrate and a cap,

said cap including at least one protrusion for limiting an amount of flexing of the substrate during actuation, said at least one protrusion extending to a predetermined distance above a surface of the substrate when the module is sealed.

40. The assembly according to claim 39, wherein said cap protects and provides a heat transfer path.

41. The assembly according to claim 39, wherein said predetermined distance is within a range of about 0.000 inches to about 0.003 inches above the substrate surface.

42. The assembly according to claim 39, wherein the protrusions are protrusion is formed on a same plane as a bottom surface of said cap,

wherein the cap includes sealing legs at an outer periphery thereof, and a bottom surface of the at least one protrusion is substantially on a same plane as an interface between the bottom

surface of the sealing legs of the cap and a seal band, and such that a clearance of substantially within a range of about 0.000 inches to about 0.003 inches, is provided between the bottom of the protrusions and the opposing surface of the substrate.

43. The assembly according to claim 39, wherein said at least one protrusion extends not completely to a surface of the substrate opposing said at least one protrusion.

44. The assembly according to claim 39, wherein said at least one protrusion is preloaded against said substrate.

45. The assembly according to claim 39, wherein said at least one protrusion is gimbaled or otherwise includes a movable contact surface which self-registers against the substrate or an opposite contact surface.

46. The assembly according to claim 39, wherein said at least one protrusion is capped with an elastomer layer.

47. The assembly according to claim 39, wherein said substrate includes an elastomer member mounted in an area of said substrate corresponding to said at least one protrusion when the cap is joined to said substrate.

48. The assembly according to claim 39, wherein said at least one protrusion includes one of a rounded surface and a spherical contact surfaced for centered contact.

49. The assembly according to claim 39, wherein said at least one protrusion is located about 1/3 to 1/4 of the diagonal distance from a center to a corner of the substrate.

50. The assembly according to claim 39, wherein said at least one protrusion is located substantially near the center of said substrate.

51. The assembly according to claim 39, wherein said cap includes sealing legs at a periphery of said cap, and a bottom surface of said at least one protrusion is substantially on a same plane as an interface between the bottom surface of the sealing legs of the cap and such that a clearance of substantially within a range of about 0.000 inches to about 0.003 inches, is provided between the bottom of said at least one protrusion and the opposing surface of the substrate.

52. The assembly according to claim 39, wherein said at least one protrusion is integrally formed with said cap.

53. The assembly according to claim 39, wherein said at least one protrusion is rigidly fixed to said cap.

54. The assembly according to claim 39, wherein said at least one protrusion is attached permanently to said substrate.

55. The assembly according to claim 39, wherein said at least one protrusion is formed as walls of said cap.

56. The assembly according to claim 39, wherein a position of said at least one protrusion is selectively adjustable in relation to said substrate to accommodate different stresses and loading on said substrate.

57. The assembly according to claim 56, wherein said at least one protrusion comprises an adjustable spar, a screw or a set-screw.

58. The assembly according to claim 56, wherein said at least one protrusion is rotated to be threaded through said cap to adjust a distance of a bottom of said protrusion from a top surface of said substrate.

59. The assembly according to claim 56, wherein said at least one protrusion comprises a rivet for being adjustably inserted through said cap.

60. The assembly according to claim 56, wherein said at least one protrusion comprises a threaded cylindrical object.

61. The assembly according to claim 56, wherein said at least one protrusion is adjustably fitted through said cap such that a bottom surface of said at least one protrusion is flush with a top surface of said substrate.

62. The assembly according to claim 56, wherein said at least one protrusion is adjustably fitted to form a predetermined gap between a tip of said at least one protrusion and said substrate.

63. The assembly according to claim 56, wherein said at least one protrusion includes threads which are sealed to prevent leakage and retain the protrusion position.

64. The assembly according to claim 56, wherein an interposing layer of curable or hardened material is interposed between said at least one protrusion and said substrate.

65. The assembly according to claim 56, wherein said curable or hardened material comprises epoxy.

66. The assembly according to claim 39, further comprising:

a contact plate formed on said substrate for spreading a reaction load between said at least one protrusion and said substrate.

67. The assembly according to claim 66, wherein said contact plate comprises steel or another material having a hardness substantially the same as steel.

68. The assembly according to claim 66, wherein said contact plate comprises a cylindrical plate or column.

69. The assembly according to claim 66, wherein said contact plate is attached to said substrate.

70. The assembly according to claim 66, wherein said contact plate is pre-attached to a tip of said at least one protrusion.

71. The assembly according to claim 70, wherein said contact plate is gimbaled or otherwise includes a movable contact surface which self-registers against the substrate or an opposite contact surface.

72. The assembly according to claim 66, wherein said contact plate protects a surface of said substrate from scratching damage.

73. The assembly according to claim 66, wherein said contact plate protects said substrate from excessive surface pressure.

74. The assembly according to claim 66, wherein said contact plate is retained and located with a counterbore in said substrate.

75. The assembly according to claim 66, wherein said contact plate includes at least one rounded contact surface for centered contact to said at least one protrusion.

76. A method of forming a land grid assembly (LGA) module, said method comprising:

preparing a cap including sealing legs respectively extending from peripheral ends of a first surface of said cap, and at least one integrally formed protrusion on said first surface of said cap intermediate said sealing legs; and

joining a substrate to said sealing legs to form a sealed module, said at least one protrusion extending to a predetermined distance above a surface of the substrate when the module is sealed,

wherein during a load condition on said substrate, said at least one protrusion suppresses an amount of flexing of said substrate.

77. The method according to claim 76, wherein said cap is for mechanically protecting a chip mounted on said substrate, and for providing a heat transfer path from a back side of the chip to an external cooling environment.

78. The method according to claim 76, wherein said at least one protrusion is a predetermined distance from an opposing surface of said substrate during an unloaded state of said module, said predetermined distance being substantially within a range of about 0.000 inches to about 0.003 inches above the substrate surface.

79. The method according to claim 76, wherein said at least one protrusion is formed on a same plane as a bottom surface of said cap.

80. The method according to claim 76, wherein said at least one protrusion extends not completely to a surface of the substrate opposing said at least one protrusion.

81. The method according to claim 76, wherein said at least one protrusion is preloaded against said substrate.

82. The method according to claim 76, wherein said at least one protrusion is gimbaled or otherwise includes a movable contact surface which self-registers against the substrate or an opposite contact surface.

83. The method according to claim 76, further comprising capping the at least one protrusion with an elastomer layer.

84. The method according to claim 76, further comprising mounting an elastomer member in an area of said substrate corresponding to said at least one protrusion when the cap is joined to said substrate.

85. The method according to claim 76, wherein said at least one protrusion includes one of a rounded surface and a spherical contact surfaced for centered contact.

86. The method according to claim 76, wherein the at least one protrusion is located substantially within a range of about 1/3 to about 1/4 the diagonal distance from a center to a corner of the substrate.

87. The method according to claim 76, wherein said at least one protrusion is located substantially near the center of said substrate.

88. The method according to claim 76, wherein a bottom surface of said at least one protrusion is substantially on a same plane as an interface between the bottom surface of the sealing legs of the cap and such that a clearance of substantially within a range of about 0.000 inches to about 0.003 inches, is provided between the bottom of said at least one protrusion and the opposing surface of the substrate.

89. The method according to claim 76, wherein said at least one protrusion is integrally formed with said cap.

90. The method according to claim 76, wherein said at least one protrusion is rigidly fixed to said cap.

91. The method according to claim 76, wherein said at least one protrusion is attached permanently to said substrate.

92. The method according to claim 76, wherein said at least one protrusion is formed as walls of said cap.

93. The method according to claim 76, wherein a position of said at least one protrusion is selectively adjustable in relation to said substrate to accommodate different stresses and loading on said substrate.

94. The method according to claim 93, wherein said at least one protrusion comprises an adjustable spar, a screw or a set-screw.

95. The method according to claim 93, further comprising rotating said at least one protrusion to be threaded through said cap to adjust a distance of a bottom of said protrusion from a top surface of said substrate.

96. The method according to claim 93, wherein said at least one protrusion comprises a rivet for being adjustably inserted through said cap.

97. The method according to claim 93, wherein said at least one protrusion comprises a threaded cylindrical object.

98. The method according to claim 93, further comprising adjustably fitting said at least one protrusion through said cap such that a bottom surface of said at least one protrusion is flush with a top surface of said substrate.

99. The method according to claim 93, wherein said at least one protrusion is adjustably fitted to form a predetermined gap between a tip of said at least one protrusion and said substrate.

100. The method according to claim 93, wherein said at least one protrusion includes threads which are sealed to prevent leakage and retain the protrusion position.

101. The method according to claim 93, wherein an interposing layer of curable or hardened material is interposed between said at least one protrusion and said substrate.

102. The method according to claim 101, wherein said curable or hardened material comprises epoxy.

103. The method according to claim 76, further comprising:

forming a contact plate formed on said substrate for spreading a reaction load between said at least one protrusion and said substrate.

104. The method according to claim 103, wherein said contact plate comprises steel or another material having a hardness substantially the same as steel.

105. The method according to claim 103, wherein said contact plate comprises a cylindrical plate or column.

106. The method according to claim 103, wherein said contact plate is attached to said substrate.

107. The method according to claim 103, wherein said contact plate is pre-attached to a tip of said at least one protrusion.

108. The method according to claim 107, wherein said contact plate is gimbaled or otherwise includes a movable contact surface which self-registers against the substrate or an opposite contact surface.

109. The method according to claim 103, wherein said contact plate protects a surface of said substrate from scratching damage.

110. The method according to claim 103, wherein said contact plate protects said substrate from excessive surface pressure.

111. The method according to claim 103, wherein said contact plate is retained and located with a counterbore in said substrate.

112. The method according to claim 103, wherein said contact plate includes at least one rounded contact surface for centered contact to said at least one protrusion.

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